

### REMARKS

Claims 1-16 are presently pending in the application.

Claim 1 has been amended to place it in better form and to recite that the cyclic carbonic acid ester containing at least one carbon-carbon unsaturated bond (B) comprises vinylethylene carbonate. This amendment is supported in the specification at least at page 8, lines 6-10 and in Example 6. Claims 4, 6, and 7 have been amended to correctly depend from amended claim 1. Finally, new claim 16 incorporates the subject matter from claim 1 and recites that the solute comprises both  $\text{LiPF}_6$  and  $\text{LiBF}_4$ , which is supported at least at page 10, lines 5-6, page 15, line 13 to page 16, line 1, and in Example 5. No new matter has been added by these amendments.

In Paper No. 5, the Examiner has rejected claims 1-14 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent Application Publication No. 2003/0077517 of Nakanishi et al. ("Nakanishi"). The Examiner has also rejected claims 1-9 and 12-14 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,162,264 of Miyazaki et al. ("Miyazaki"). Further, claims 1-9 and 12-15 have been rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent Application Publication No. 2003/0118913 of Takami et al. ("Takami"). The Examiner has rejected claims 10-11 under 35 U.S.C. § 103(a) as being unpatentable over Miyazaki in view of EP 0796510 ("EP '510") and as being unpatentable over Takami in view of EP '510. Finally, claim 15 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Miyazaki in view of U.S. Patent Application Publication No. 2002/0001756 of Hamamoto et al. ("Hamamoto"). Applicants respectfully traverse these rejections and the arguments in support thereof as follows, and respectfully request reconsideration and withdrawal of the rejections.

#### *Rejection Under §102(e) Based on Nakanishi*

Regarding claims 1-11, the Examiner argues that Nakanishi teaches a lithium secondary battery comprising a positive electrode, a negative electrode, and a non-aqueous electrolyte containing a solvent and an electrolyte salt, and that a cyclic carbonic acid ester or cyclic carboxylic acid ester is used as a solvent (paragraph [0007]). Examples of the non-aqueous solvent are exemplified in paragraph [0027], the Examiner contends. The Examiner

further argues that Nakanishi discloses that one or more of these solvents may be used, particularly when the solvent contains one or more cyclic carbonic acid ester, cyclic carboxylic acid ester, non-cyclic carbonic acid ester or aliphatic carboxylic acid ester. Regarding claims 12-13, the Examiner contends that Nakanishi discloses the active material of the positive electrode in paragraph [0031], and in particular teaches a lithium-containing composite transition metal oxide containing Co in which part of the transition metal is replaced with Mg, and further that the negative electrode material includes artificial or natural graphite. Finally, regarding claim 14, the Examiner argues that Nakanishi teaches that as the electrolyte, lithium salts including those comprising  $\text{LiPF}_6$ ,  $\text{LiBF}_4$ ,  $\text{LiAsF}_6$ , and  $\text{LiSbF}_6$  may be used. Applicants respectfully traverse this rejection as follows.

The present invention is directed to a non-aqueous electrolyte secondary battery containing a positive electrode, negative electrode, and a non-aqueous electrolyte which contains a solute dissolved in a non-aqueous solvent. The non-aqueous solvent comprises: (A) a cyclic carboxylic acid ester; (B) a cyclic carbonic acid ester having at least one carbon-carbon unsaturated bond; and (C) a cyclic carbonic acid ester having no carbon-carbon unsaturated bond. Further, the carbonic acid ester (B) contains vinylethylene carbonate (VEC). As demonstrated in Table 13 of Example 6 of the present application, inclusion of VEC in the carbonic acid ester (B) decreases the amount of generated gas from 3.0 to 1.9 ml when compared with a non-aqueous electrolyte battery in which the solvent contains a cyclic carbonic ester which does not comprise VEC.

In contrast, Nakanishi does not teach or suggest a non-aqueous solvent which contains VEC. Rather, although Nakanishi discloses a variety of non-aqueous solvents in paragraph [0027] which may be used alone or in combination with one another in the non-aqueous electrolyte secondary battery, Nakanishi does not teach VEC, which is a critical component of the solvent according to the present invention. Further, the present invention requires that the solvent contain three components (A), (B) and (C), in which (B) comprises VEC. Although components (A), (B) and (C) are generally taught by Nakanishi as potential solvents, Nakanishi does not teach or suggest a solvent which comprises all three claimed components. In fact, the solvents in the Examples of Nakanishi contain combinations of ethylene carbonate and ethylmethyl carbonate, a cyclic carbonic acid ester according to (C) and a non-cyclic carbonic acid. Accordingly, since Nakanishi does not teach or suggest all of the

claimed elements, Nakanishi does not anticipate the pending claims, and reconsideration and withdrawal of the § 102(e) rejection are respectfully requested.

Moreover, since Nakanishi and the present application have the same Assignee, Matsushita Electric Industrial Co., Ltd., this §102(e) reference cannot be used as prior art for a §103(a) rejection. Therefore, even if the Examiner were to argue that the pending claims are obvious based on Nakanishi alone or in combination with a secondary reference, such §103(a) rejection would be improper.

*Rejection Under §102(b) Based on Miyazaki*

The Examiner argues, regarding claims 1-9, that Miyazaki discloses a lithium cylindrical ion secondary battery comprising a positive electrode, negative electrode, and a non-aqueous electrolyte obtained by dissolving a lithium salt in a solvent. The organic solvents disclosed by Miyazaki allegedly anticipate the pending claims. Regarding claims 12-13, the Examiner contends that Miyazaki teaches the claimed positive and negative electrode active materials. Finally, the Examiner contends that the lithium salts taught by Miyazaki anticipate claim 14. Applicants respectfully traverse this rejection as follows.

As previously explained, the non-aqueous solvent according to the present invention comprises a cyclic carbonic ester which contains VEC. Miyazaki discloses that a cyclic ester such as propylene carbonate, butylene carbonate,  $\gamma$ -buthyrolactone, vinylene carbonate, 2-methyl- $\gamma$ -buthyrolactone, acetyl- $\gamma$ -buthyrolactone, or  $\gamma$ -valerolactone may be used as the solvent, in addition to chain esters, cyclic ethers, chain ethers, or the like (col. 15, lines 31-50). However, Miyazaki does not teach or suggest a solvent comprising a cyclic carbonic ester which contains VEC, and also does not teach or suggest a non-aqueous solvent which contains components (A), (B), and (C) as claimed. Therefore, since Miyazaki does not teach or suggest the claimed solvent, Miyazaki does not anticipate the pending claims, and reconsideration and withdrawal of the § 102(b) rejection are respectfully requested.

*Rejection Under §102(b) Based on Takami*

The Examiner argues, regarding claims 1-9, that Takami teaches a non-aqueous electrolyte secondary battery comprising an electrode group including a positive electrode, a negative electrode and a non-aqueous electrolyte which includes solvent and lithium salt

dissolved therein. Takami further allegedly discloses in paragraphs [0057]-[0059] and in Examples 15-18 specific mixed solvents containing  $\gamma$ -butyrolactone and additional components which anticipate the claimed non-aqueous solvent. Regarding claims 12-13, the Examiner argues that Takami discloses the claimed positive and negative electrode materials. Further, the Examiner contends that the salt electrolytes listed in paragraph [0064] anticipate those recited in claim 14, and that Takami teaches in paragraph [0063] a solvent comprising a benzene-like or derivative compound, which the Examiner argues anticipates claim 15. Finally, Example 41 allegedly shows a specific solvent mixing solution. Applicants respectfully traverse this rejection.

As previously explained, the non-aqueous solvent according to the present invention comprises a cyclic carbonic ester which contains VEC. In paragraphs [0057] to [0059], Takami teaches a mixed non-aqueous solvent which contains  $\gamma$ -butyrolactone as a main component, combined with a cyclic carbonate such as propylene carbonate, ethylene carbonate, or vinylene carbonate. However, Takami does not teach that the solvent may comprise VEC, nor that the solvent must contain VEC in addition to a cyclic carboxylic acid ester and a cyclic carbonic ester having no carbon-carbon unsaturated bond as claimed. Therefore, since Takami does not teach or suggest the claimed solvent, Takami does not anticipate the pending claims, and reconsideration and withdrawal of the § 102(b) rejection are respectfully requested.

*Rejection Under §103(a) Based on Miyazaki in view of EP '510*

The Examiner acknowledges that Miyazaki does not teach a solvent comprising a glyme, as recited in claims 10-11. However, the Examiner argues that EP '510 discloses a non-aqueous electrolyte system consisting of a solvent mixture containing ethylene carbonate,  $\gamma$ -valerolactone and optionally one or more additional solvents such as other organic carbonates, including glymes. The batteries of EP '510 can allegedly be applied in a broad voltage range, have conductivity higher than conventional conductivities at room temperature, and show high stability against reduction. In view of these teachings, the Examiner argues that it would have been obvious to one skilled in the art at the time of the invention to use the solvent comprising a glyme of EP '510 in the solvent mixture of Miyazaki. Applicants respectfully traverse this rejection as follows.

As previously explained, Miyazaki does not teach or suggest the claimed non-aqueous solvent containing a cyclic carbonic ester which contains VEC, and EP '510 does not cure this deficiency. Rather, EP '510 teaches a solvent containing at least 50 mol% of a mixture of ethylene carbonate and  $\gamma$ -valerolactone. The solvent may contain one or more additional solvents including organic carbonate, other lactones, esters or glymes (paragraph [0011]). However, EP '510 does not teach VEC as a possible solvent nor a solvent which contains, in addition to VEC, components (A) and (C). Therefore, even the combination proposed by the Examiner would not teach or suggest all of the claimed elements, and no *prima facie* case of obviousness has been established by the Examiner.

Furthermore, as previously explained, when a battery is formed using a non-aqueous solvent which contains a cyclic carbonic ester comprising VEC, the amount of generated gas decreases from 3.0 to 1.9 ml compared with a battery containing a cyclic carbonic ester which does not comprise VEC (Table 13), a favorable result. Since neither Miyazaki nor EP '510 teaches VEC, it would not be expected based on these references, alone or in combination, that inclusion of this particular component would result in such a dramatic decrease in the amount of generated gas. Accordingly, even if a *prima facie* case of obviousness had been established based on the proposed combination of Miyazaki and EP '510, it would be overcome by the unexpected results of Applicants' invention. Therefore, reconsideration and withdrawal of the §103(a) rejection are respectfully requested.

*Rejection Under §103(a) Based on Takami in view of EP '510*

The Examiner acknowledges that Takami does not teach a solvent comprising a glime. However, as previously explained, EP '510 allegedly discloses a non-aqueous electrolyte system consisting of a solvent mixture containing ethylene carbonate,  $\gamma$ -valerolactone and optionally an additional solvent, such as a glyme. In view of the teachings of EP '510, the Examiner argues that it would have been obvious to one skilled in the art at the time of the invention to use the solvent comprising a glime of EP '510 in the solvent mixture of Takami. Applicants respectfully traverse this rejection as follows.

As previously explained, Takami does not teach or suggest the claimed non-aqueous solvent containing a cyclic carbonic ester which contains VEC, and EP '510 does not

cure this deficiency. Therefore, even the proposed combination of references would not teach or suggest all of the claimed elements, and no *prima facie* case of obviousness has been established.

Furthermore, since neither Takami nor EP '510 teaches a cyclic carbonic ester containing VEC, it would not be expected based on the proposed combination of these references that inclusion of VEC would reduce the amount of gas generated, as exemplified by the present invention. Such unexpected results, as previously explained, would overcome any case of *prima facie* obviousness. Accordingly, reconsideration and withdrawal of the §103(a) rejection are respectfully requested.

*Rejection Under §103(a) Based on Miyazaki in view of Hamamoto*

The Examiner acknowledges that Miyazaki does not disclose that the solvent comprises a derivative of benzene. However, Hamamoto allegedly teaches in the abstract that a non-aqueous electrolytic solution which may be used for a lithium secondary battery employs a non-aqueous electrolytic solution which comprises a non-aqueous solvent and an electrolyte which contains a biphenyl derivative. In view of these teachings, the Examiner concludes that it would have been obvious to one having ordinary skill in the art at the time of the invention to use the solvent of Hamamoto comprising a derivative of benzene in the solvent mixture of Miyazaki, as Hamamoto teaches that by using the benzene derivative as a solvent, a non-aqueous electrolytic solution which is favorably employable for a lithium secondary battery and which shows high battery performance such as high electric capacity and high cycling performance under maximum operation voltage condition or elevated temperature is obtained. Applicants respectfully traverse this rejection as follows.

As previously explained, Miyazaki does not teach or suggest the claimed non-aqueous solvent containing a cyclic carbonic ester which contains VEC, and Hamamoto does not cure this deficiency. In particular, Hamamoto in paragraph [0018] teaches that the non-aqueous solvent preferably comprises a combination of a cyclic carbonate and a linear chain carbonate, a high dielectric constant solvent such as ethylene carbonate, propylene carbonate, or butylene carbonate, and a low viscosity solvent, such as  $\gamma$ -butyrolactone or dimethyl carbonate, for example. However, Hamamoto does not teach or suggest VEC, nor a solvent which contains, in addition to VEC, a category (A) and a category (C) component. Therefore, even the proposed

combination of references would not teach or suggest all of the claimed elements, and no *prima facie* case of obviousness has been established by the Examiner.

Furthermore, even if a case of *prima facie* obviousness had been established, the unexpected results of Applicants' invention, as previously explained, would overcome such a case. Therefore, reconsideration and withdrawal of the §103(a) rejection are respectfully requested.

Finally, new claim 16 recites that the solute in the non-aqueous electrolyte comprises both  $\text{LiPF}_6$  and  $\text{LiBF}_4$ . By using such a non-aqueous electrolyte in a non-aqueous battery according to the invention, battery cycle characteristics are improved, as described in the present application at page 15, line 26 to page 16, line 1. Further, in Example 5, cycle life and the amount of generated gas were examined for a series of batteries in which the mixing molar ratio of  $\text{LiPF}_6$  to  $\text{LiBF}_4$  were varied while the total concentration of  $\text{LiPF}_6$  and  $\text{LiBF}_4$  were kept constant. As shown in Table 11, for example, batteries 2F and 3F, which included both  $\text{LiPF}_6$  and  $\text{LiBF}_4$  as the solute, exhibited an improvement in cycle life and a decrease in the amount of generated gas, both favorable and desirable results. In contrast, none of the cited prior art teaches or suggests a solute containing both  $\text{LiPF}_6$  and  $\text{LiBF}_4$ . Further, none of the prior art suggests the unexpected and unique results which have been obtained by Applicants by including the combination of the two lithium salts in the non-aqueous electrolyte. Accordingly, Applicants respectfully submit that claim 16 is patentable over the prior art of record.

Application No. 10/058,707

Reply to Office Action of September 25, 2003

In view of the preceding amendments and remarks, Applicants respectfully submit that all of the pending claims are patentably distinct over the prior art of record and in condition for allowance. A Notice of Allowance is respectfully requested.

Respectfully submitted,

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